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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 042390.P5358 Total Pages 5

First Named Inventor or Application Identifier Robert J. Woodruff

Express Mail Label No. EM335898406US

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, D. C. 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 23)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 7)

4. X Oath or Declaration (Total Pages 5)

a. X Newly Executed (Original or Copy)

b. ___ Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**

i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ___ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ___ Microfiche Computer Program (Appendix)

7. ___ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ___ Computer Readable Copy
b. ___ Paper Copy (identical to computer copy)
c. ___ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. X Assignment Papers (cover sheet & documents(s))
9. ____ a. 37 CFR 3.73(b) Statement (where there is an assignee)
____ b. Power of Attorney
10. ____ English Translation Document (if applicable)
11. ____ a. Information Disclosure Statement (IDS)/PTO-1449
____ b. Copies of IDS Citations
12. ____ Preliminary Amendment
13. X Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. ____ a. Small Entity Statement(s)
b. Statement filed in prior application, Status still proper and desired
15. ____ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. X Other: Express Mail Certificate of Mailing and copy of Postcard

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:
___ Continuation ____ Divisional ____ Continuation-in-part (CIP)
of prior application No: _____

18. **Correspondence Address**

____ Customer Number or Bar Code Label _____
(Insert Customer No. or Attach Bar Code Label here)

or

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PTO/SB/17(10/96)
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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL

TOTAL AMOUNT OF PAYMENT ($) 1038.00

Complete if Known:
Application No. _____
Filing Date July 15, 1998
First Named Inventor Robert J. Woodruff
Group Art Unit _____
Examiner Name _____
Attorney Docket No. 042390.P5358

METHOD OF PAYMENT (check one)

1. [ ] The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

   Deposit Account Number 022666
   Deposit Account Name _____

   [X] Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

   [ ] Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance, 37 CFR 1.131(b)

2. X Payment Enclosed
   X Check
   _____ Money Order
   _____ Other

FEE CALCULATION (fees effective 10/01/97)

1. FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	790	201	395	Utility application filing fee	790.00
106	330	206	165	Design application filing fee	
107	540	207	270	Plant filing fee	
108	790	208	395	Reissue filing fee	
114	150	214	75	Provisional application filing fee	

SUBTOTAL (1) $ 790.00

2. CLAIMS

		Extra		Fee from below		Fee Paid
Total Claims 22	− 20 =	2	X	22.00	=	44.00
Independent Claims 5	− 3 =	2	X	82.00	=	164.00
Multiple Dependent Claims			X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
103	22	203	11	Claims in excess of twenty	44.00
102	82	202	41	Independent claims in excess of 3	164.00
104	270	204	135	Multiple dependent claim	
109	82	209	41	Reissue independent claims over original patent	
110	22	210	11	Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) $ 208.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	400	216	200	Extension for response within second month	
117	950	217	475	Extension for response within third month	
118	1,510	218	755	Extension for response within fourth month	
128	2,060	228	1,030	Extension for response within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,320	241	660	Petition to revive unintentionally abandoned application	
142	1,320	242	660	Utility issue fee (or reissue)	
143	450	243	225	Design issue fee	
144	670	244	335	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40.00
146	790	246	395	For filing a submission after final rejection (see 37 CFR 1.129(a))	
149	790	249	395	For each additional invention to be examined (see 37 CFR 1.129(a))	
Other fee (specify)					
Other fee (specify)					

SUBTOTAL (3) $ 40.00

*Reduced by Basic Filing Fee Paid

SUBMITTED BY:

Typed or Printed Name: LAWRENCE M. CHO

Signature: Lawrence M. Cho Date: July 13, 1998

Reg. Number: 39,942 Deposit Account User ID: _____ (complete if applicable)

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Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR PERFORMING FIELD DIAGNOSTICS ON A COMPUTER SYSTEM

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Attorney's Docket No. 042390.P5358

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Annette Jacobs
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METHOD AND APPARATUS FOR PERFORMING FIELD DIAGNOSTICS ON A COMPUTER SYSTEM

FIELD OF THE INVENTION

The present invention relates to the field of computer systems. More specifically, the present invention relates to a method and apparatus for performing field diagnostics on a computer system.

BACKGROUND OF THE INVENTION

Diagnostic software such as AMIDiag by American Megatrends, Inc. and QAPlus® by DiagSoft, Inc. provide trouble shooting capabilities for diagnosing problems with server computer systems. AMIDiag and QAPlus perform tests on the server computer systems' memory, CPU, video controller, serial ports, parallel ports, disks, modems chipsets, and other components on the server computer systems.

Typically, when a server computer system experiences problems, a service technician is dispatched to the site of the server computer system to perform diagnostics on the server computer system. Typically, the service technician is required to reset the server computer system and load a diagnostic environment onto the computer system server. The service technician may then run a diagnostic program such as AMIDiag, QAPlus, or other diagnostic program in order to determine the source of the problem. Upon determining the source of the problem, the service technician may be required to obtain a piece of hardware or a software program to repair the server computer system. Thus, the service technician may be required to make more than one visit to the site of the server computer system. The drawback with this approach is that additional delay and costs are incurred when a service technician is required to make multiple visits to the remote location to diagnose and repair the server computer system. Similar problems also exist when desktop computer systems, main frame computer systems, or other computer systems require diagnosis and repair.

SUMMARY OF THE INVENTION

A method for managing a computer system is disclosed. A reset of the computer system is initiated from a remote location. Diagnostic software downloaded from the remote location is run on the computer system.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings, in which the like references indicate similar elements in and in which:

Figure 1 illustrates a computer system and a remote management console according to an embodiment of the present invention;

Figure 2 illustrates a block diagram of a computer system implementing an embodiment of the present invention;

Figure 3 is a block diagram illustrating the Basic Input Output System (BIOS) according to an embodiment of the present invention;

Figure 4 is a block diagram illustrating a console diagnostic tester according to an embodiment of the present invention;

Figure 5 is a block diagram illustrating a system diagnostic tester according to an embodiment of the present invention;

Figure 6 is a flow chart illustrating a method for managing a computer system according to a first embodiment of the present invention; and

Figure 7 is a flow chart illustrating a method for managing a computer system according to a second embodiment of the present invention.

DETAILED DESCRIPTION

Figure 1 illustrates a computer system 110 and a remote management console 120 according to an embodiment of the present invention. The computer system 110 may be a server computer system, a desktop or a laptop personal computer (PC), a main frame computer system, or other computer system. The remote management console 120 resides in a location that is remote with respect to the computer system 110. The remote management console 120 may be a server computer system, a desktop or laptop PC, a main frame computer system, or other computer system. The remote management console 120 is coupled to the computer system 110 via a transmission medium 130. The computer system 110 and the remote management console 120 transmit data to each other via the transmission medium 130. The transmission medium 130 may be fiber optics, cable, twisted pair, microwave, or other transmission media. The computer system 110 and the remote computer system 120 may be coupled to the transmission medium 130 via a Ethernet connection, a serial connection, a modem connection, or other connection.

According to an embodiment of the present invention, the remote management console 120 is used to perform diagnostics on the computer system 110. The remote management console 120 initiates a remote connection with the computer system 110 via the transmission medium 130. The remote connection may be supported by the computer system 110 via a management module 111. The management module 111 may be, for example, an INTEL Server Monitor Module (SMM). The management module 111 includes a secondary processor (not shown) and a communications interface (not shown) that may be used to interface a remote computer system such as the remote management console 120 without the assistance of other components in the computer system 110. The management module 111 may be used to provide support for the computer system 110 when components in or around the computer system 110 experience failure. For example, the management module 111 may support out of band access for use when the operating system is not functional or when a network connected to a network controller on the

computer system 110 is down, remote control of the operating system, system shutdown, and access to system state information to aid in problem diagnosis. According to an embodiment of the present invention, the management module 111 may be used to connect to the remote management console 120 via an Ethernet connection, modem connection, or other connection. The remote management console 120 may initiate a connection with the computer system 110 via a serial interface 112. The serial interface 112 may be used as a communications interface to directly connect the remote management console 120 with the computer system 110 or indirectly connect the remote management console 120 with the computer system 110 via a modem (not shown).

The remote management console 120 sends a signal to a shutdown agent on the computer system 110 to initiate a shutdown and reset of the computer system 110. By resetting the computer system 110, the computer system will execute its Basic Input Output System (BIOS) code. The BIOS code includes a boot strap loader. When executed, the boot strap loader puts the computer system 110 in a diagnostic state. The boot strap loader recognizes when a connection from the remote management console 120 has been established. The boot strap loader may be used to authorize a diagnostic session request from the remote management console 120, provide the remote management console 120 with information about the computer system 110, and provide support in downloading diagnostic software code from the remote management console 120 directly into a memory in the computer system 110. The diagnostic software code may be executed by a processor (not shown) in the computer system 110 to generate a diagnostic report of the condition of the computer system 110 to the remote management console 120.

Figure 2 illustrates a block diagram of a computer system 200 that may be implemented as the computer system 110 (shown in Figure 1) or the remote management console 120 (shown in Figure 1). The computer system 200 includes a processor 201 that processes data signals. The processor 201 may be a complex instruction set computer (CISC) microprocessor, a reduced instruction set computing (RISC) microprocessor, a

very long instruction word (VLIW) microprocessor, a processor implementing a combination of instruction sets, or other processor device. Figure 2 shows an example of the present invention implemented on a single processor computer system 200. However, it is understood that the present invention may be implemented in a computer system having multiple processors. The processor 201 is coupled to a CPU bus 210 that transmits data signals between processor 201 and other components in the computer system 200.

The computer system 200 includes a memory 213. The memory 213 may be a dynamic random access memory (DRAM) device, a static random access memory (SRAM) device, or other memory device. The memory 213 may store instructions and code represented by data signals that may be executed by the processor 201. A cache memory 202 may reside inside the processor 201 to store data signals stored in the memory 213. The cache 202 speeds up memory accesses by the processor 201 by taking advantage of its locality of access. In an alternate embodiment of the computer system 200, the cache 202 resides external to the processor 201.

A bridge memory controller 211 may be coupled to the CPU bus 210 and the memory 213. The bridge memory controller 211 directs data signals between the processor 201, the memory 213, and other components in the computer system 200 and bridges the data signals between the CPU bus 210, the memory 213, and a first I/O bus 220.

The first I/O bus 220 may be a single bus or a combination of multiple buses. As an example, the first I/O bus 220 may comprise a Peripheral Component Interconnect (PCI) bus, a Personal Computer Memory Card International Association (PCMCIA) bus, a NuBus, or other buses. The first I/O bus 220 provides communication links between components in the computer system 200. A network controller 221 may be coupled to the first I/O bus 220. The network controller 221 links the computer system 200 to a network of computers (not shown in Figure 2) and supports communication among the machines. A display device controller 222 may be coupled to the first I/O bus 220. The display device controller 222 allows coupling of a display device to the computer system 200 and acts as

an interface between the display device and the computer system 200. The display device controller may be a monochrome display adapter (MDA) card, a color graphics adapter (CGA) card, an enhanced graphics adapter (EGA) card, an extended graphics array (XGA) card or other display device controller. The display device may be a television set, a computer monitor, a flat panel display or other display device. The display device receives data signals from the processor 201 through the display device controller 222 and displays the information and data signals to the user of the computer system 200. A video camera 223 may be coupled to the first I/O bus 220. The video camera 220 operates to capture an image of an object. The video camera 223 may be a digital video camera having internal digital video capture hardware that translates the captured image into digital graphical data. The video camera 223 may be an analog video camera having digital video capture hardware external to the video camera 223 for digitizing the captured image.

A management module 111 may be coupled to the first I/O bus 220 in an embodiment of the computer system 200 where the computer system 200 is implemented as the computer system 110. The management module 111 includes a secondary processor 225 that may be used by the remote management console 120 (shown in Figure 1) as a shutdown agent. The management module 111 includes a communications interface 226 that may be used to interface the remote management console 120 without the assistance of other components in the computer system 200.

A second I/O bus 230 may be a single bus or a combination of multiple buses. As an example, the second I/O bus 230 may comprise a PCI bus, a PCMCIA bus, a NuBus, an Industry Standard Architecture (ISA) bus, or other buses. The second I/O bus 230 provides communication links between components in the computer system 200. A data storage device 231 may be coupled to the second I/O bus 230. The data storage device 231 may be a hard disk drive, a floppy disk drive, a CD-ROM device, a flash memory device or other mass storage device.

A read only memory (ROM) 232 may be coupled to the second I/O bus. The ROM 232 is nonvolatile memory that stores data that is executed by the processor 201. The ROM 232 may be used to store the computer system's BIOS. A BIOS provides the computer system with a basic set of instructions to perform during system boot up. The instructions may include tests as well as directions required to control peripherals on the computer system.

A serial interface 112 may be coupled to the second I/O bus 230 in an embodiment of the computer system 200 where the computer system 200 is implemented as the computer system 110. The serial interface 112 may be used as a general-purpose interface to connect devices including modems, mice, and printers. According to an embodiment of the present invention, the serial interface 112 may be used as a communications interface to directly connect the remote management console 120 with the computer system 200. According to an alternate embodiment of the present invention, the serial interface 112 may be used as a communications interface to connect the remote management console 120 with the computer system 200 via a modem (not shown). A secondary processor (not shown) may be connected between the secondary I/O bus 230 and the serial interface 112 to support the serial interface 112. The secondary processor may be used by the remote management console 120 as a shutdown agent.

A keyboard interface 233 may be coupled to the second I/O bus 230. The keyboard interface 233 may be a keyboard controller or other keyboard interface. The keyboard interface 233 may be a dedicated device or can reside in another device such as a bus controller or other controller. The keyboard interface 233 allows coupling of a keyboard to the computer system 200 and transmits data signals from a keyboard to the computer system 200. An audio controller 234 may be coupled to the second I/O bus 230. The audio controller 234 operates to coordinate the recording and playing of sounds is also coupled to the I/O bus 230. A bus bridge 224 couples the first I/O bus 220 to the second

I/O bus 230. The bus bridge 224 operates to buffer and bridge data signals between the first I/O bus 220 and the second I/O bus 230.

Figure 3 is a block diagram illustrating the BIOS 300 stored in the ROM 232 (shown in Figure 2) of computer system 110 according to an embodiment of the present invention. The BIOS 300 includes a sequence of instructions that are executed by the processor 201 (shown in Figure 2) to perform a system boot sequence when the computer system 110 is turned on. The sequence of instructions are illustrated as modules in Figure 3. The BIOS 300 includes an initialization module 310. The initialization module 310 may include a power-on self test (POST). The POST is a diagnostic program that performs a cursory check on the components in the computer system 110. The initialization module 310 may also include programs that initialize peripherals in the computer system 110, that determine the identity of the components on the computer system 110, and that perform tests on specific components in the computer system 110. The initialization module 310 generates an initialization report that describes the results of the tests performed on the computer system 110.

The BIOS 300 includes a boot strap loader module 320 that is executed after the initialization module 310 is executed. The boot strap loader module 320 includes a communications driver 321. The communications driver 321 supports a protocol of communications with the management module 111 (shown in Figures 1 and 2) or the serial interface 112 (shown in Figures 1 and 2). The communications driver 321 supports a protocol of communications with the management module 111 where data is passed to each other via a shared portion of a memory such as the memory 213 (shown in Figure 2) in the computer system 110 or other memory. The communications driver 321 may include a serial port driver that supports communications with the serial interface 112.

The boot strap loader module 320 includes a session manager 322. The session manager 322 determines whether the remote management console 120 is requesting a diagnostic session with the computer system 110. According to an embodiment of the

present invention, the session manager 322 transmits a query message to the remote computer system 120 via a communications interface 226 (shown in Figure 2) on the management module 111 or the serial interface 112. The session manager 322 monitors the communications interface 226 on the management module 111 or the serial interface 112 for a diagnostic session request message from the remote management console 120 in response to the query message.

The boot strap loader module 320 includes a session authorizer 323. The session authorizer 323 determines whether the remote management console 120 is authorized to request the diagnostic session. According to an embodiment of the present invention, the remote management console 120 transmits a diagnostic session password with a diagnostic session request message. The session authorizer 323 compares the diagnostic session password received with a stored password to determine whether the remote management console 120 has authorization to request the diagnostic session. If the remote management console 120 has authorization to request the diagnostic session, the session authorizer 323 generates a message stating that a diagnostic session was established successfully. If the remote management console 120 does not have authorization to request the diagnostic session, the session authorizer 323 generates an error message. It should be appreciated that the session authorizer 323 may reside in the management module 225 instead of the boot strap loader 320.

The boot strap loader module 324 includes a system status provider 324. The system status provider 324 provides the remote management console 120 with information about the computer system 110 to allow the remote management console 120 to determine appropriate diagnostics to download onto the computer system 110. The system status provider 324 may provide the remote management console 120 with information about the version of the BIOS 300 in the computer system 110, an initialization report that describes the results of the tests performed by the initialization module 310, or other information. It

should be appreciated that the system status provider may reside in the management module 225 instead of the boot strap loader 320.

The boot strap loader module 320 includes a data handler 325. During a diagnostic session, the data handler 325 receives data from the remote management console 120. The data includes diagnostic software code and a location in the memory 213 to write the diagnostic software code. The data handler 325 writes diagnostic software code received into locations in memory as specified by the remote management console 120. A diagnostic environment loader program may be downloaded by the data handler 325 in a situation where a two stage loading process is required. In a two stage loading process, the data handler 325 downloads the diagnostic environment loader which takes control of the downloading. The diagnostic environment loader may include functionalities which allows it to support more complicated loading operations not supported by the data handler 325.

The BIOS includes an operating system boot module 330. The operating system boot module 330 is executed when the session manager 322 determines that no diagnostic session requests are being made. The operating system boot module 330 loads an operating system into the memory 213 of the computer system 110 and runs the operating system.

According to an embodiment of the present invention, the remote management console 120 (shown in Figure 1) is used to perform field diagnostics on the computer system 110. According to one embodiment, performing field diagnostics on the computer system 110 is performed by the remote management console 120 in response to the processor 201 (shown in Figure 2) executing sequences of instructions in main memory 213 (shown in Figure 2). Such instructions may be read into memory 213 from another computer-readable medium, such as data storage device 231 (shown in Figure 2), or from another source via the network controller 221 (shown in Figure 2). Execution of the sequences of instructions causes the processor 201 to perform field diagnostics on the computer system 110, as will be described hereafter. In an alternative embodiment,

hardwired circuitry may be used in place of or in combination with software instructions to implement the present invention. Thus, the present invention is not limited to any specific combination of hardware circuitry and software.

Figure 4 is a block diagram of modules implementing a console diagnostic tester 400 according to an embodiment of the present invention. In a preferred embodiment of the present invention, the modules are implemented by software and reside in main memory 213 (shown in Figure 2) of the remote management console 120 as sequences of instructions. It should be appreciated that the modules may also be implemented by hardware as components coupled to the bus 220 (shown in Figure 2) of the remote management console 120 (shown in Figure 1) or a combination of both hardware and software.

The console diagnostic tester 400 includes a connection initiator 410. The connection initiator 410 establishes a connection between the remote management console 120 with the computer system 110. The connection initiator 410 also generates a signal to a shutdown agent on the computer system 110 to initiate a shutdown and reset of the computer system 110. Resetting the computer system 110 executes the bootstrap loader 320 (shown in Figure 3) in the BIOS 300 (shown in Figure 3) which places the computer system 110 in a diagnostic state. The console diagnostic tester 400 includes a session initiator 420. Upon receiving a query message from the computer system 110, the console diagnostic tester 400 transmits a diagnostic session request message to the computer system 110. The session initiator 420 may also transmit a diagnostic session password with the diagnostic request message. The diagnostic session password may be used by the computer system 110 to confirm that the remote management console 120 has authorization to request the diagnostic session. The console diagnostic tester 400 includes a system interrogator 430. Upon receiving a message from the computer system 110 that indicates a diagnostic session has been established successfully, the system interrogator 430 interrogates the computer system 110 for information to determine types of diagnostics to

download to the computer system 110. The system interrogator 430 may request for example a version of the BIOS on the computer system 110, an initialization report generated by the BIOS of the computer system 110, or other information. The console diagnostic tester 400 includes a data loader 440. The data loader 440 downloads data to the computer system 110. The data loader 440 downloads data that includes diagnostic software code and locations in memory to write the diagnostic software code. The diagnostic software code may include a diagnostic environment loader to assist in downloading additional data, a test run time environment, a test control agent, and diagnostic tests. The console diagnostic tester 400 includes an execution unit 450 that runs the diagnostic software downloaded on the computer system 110.

According to an embodiment of the present invention, the computer system 110 is used by the remote management console 120 to perform field diagnostics on the computer system 110. According to one embodiment, field diagnostics is performed on the computer system 110 in response to the processor 201 (shown in Figure 2) executing sequences of instructions in main memory 213 (shown in Figure 2). Such instructions may be read into memory 213 from another computer-readable medium, such as data storage device 231 (shown in Figure 2), or from another source via the network controller 221 (shown in Figure 2). Execution of the sequences of instructions causes the processor 201 to perform diagnostics on the computer system 110, as will be described hereafter. In an alternative embodiment, hardwired circuitry may be used in place of or in combination with software instructions to implement the present invention. Thus, the present invention is not limited to any specific combination of hardware circuitry and software.

Figure 5 is a block diagram of modules implementing a system diagnostic tester 500 according to an embodiment of the present invention. In a preferred embodiment of the present invention, the modules are implemented by software and reside in main memory 213 (shown in Figure 2) of the computer system 110 as sequences of instructions. It should be appreciated that the modules may also be implemented by hardware as

components coupled to the bus 220 (shown in Figure 2) or a combination of both hardware and software.

The system diagnostic tester 500 includes a diagnostic environment loader 510. The diagnostic environment loader 510 may be used to support a two stage loading process where it performs loading operations which a data handler may not support. It should be appreciated that the system diagnostic tester 500 may operate without the diagnostic environment loader 510. The system diagnostic tester 500 includes a test run time environment 520. The test run time environment 520 is a system environment that allows code to be executed. The test run time environment may be for example a Disk Operating System (DOS) or other operating system. The system diagnostic tester 500 includes a test control agent 530. The test control agent 530 is an application running in the test run time environment 520 that operates as a mechanism for the remote computer system 120 (shown in Figure 1) to determine which diagnostic tests to execute and obtain the results of the diagnostic tests. The test control agent 530 allows the remote management console 120 to manages diagnostic testing on the computer system 110. The system diagnostic tester 500 also includes diagnostic tests 540 that have been downloaded from the remote management console.

The present invention allows the remote downloading and execution of diagnostic test programs 540 onto the computer system 110 without any local user intervention. The present invention does not require a peripheral drive such as a hard drive, floppy drive, or CDROM drive to be functional on the computer system 110 to support the diagnostic session. The test run time environment 520 and diagnostic tests 540 are downloaded to memory 213 rather than run from the computer system peripheral disk drive.

Figure 6 is a flow chart illustrating a method for managing a computer system according to a first embodiment of the present invention. At step 601, the computer system is reset from a remote location. According to an embodiment of the present invention, resetting the computer system from a remote location is achieved by interfacing the

computer system via a remote connection and sending a shutdown request to a shutdown agent in the computer system via the remote connection. Interfacing the computer system via a remote connection may be achieved, for example, by interfacing the computer system via an Ethernet connection or a modem connection to a management module connected to the computer system, or interfacing the computer system via a direct connection or modem connection to a serial interface connected to the computer system.

At step 602, a diagnostic session request and a diagnostic session password is transmitted to the computer system via the remote connection.

At step 603, the computer system is interrogated to determine types of diagnostic software to download onto the computer system. According to an embodiment of the present invention, the computer system is interrogated by retrieving BIOS version information, an initialization report, or other information from the computer system. Determining types of diagnostic software to download onto the computer system may be achieved by matching a set of diagnostic tests designed for a specific BIOS version or selecting specific diagnostic tests to run on a component reported as failing a test in the initialization report.

At step 604, data is downloaded onto the computer system. According to an embodiment of the present invention, the data includes diagnostic software code and a location in memory to write the diagnostic software code. The diagnostic software code may include a diagnostic environment loader, test run time environment, test control agent, tests, or other diagnostic software code.

At step 605, the diagnostic software downloaded from the remote location is executed.

At step 606, a diagnostic report generated from the diagnostic software is transmitted to the remote location.

Figure 7 is a flow chart illustrating a method for managing a computer system according to a second embodiment of the present invention. At step 701, it is determined

whether a remote computer system is requesting a diagnostic session. If the remote computer system is not requesting a diagnostic session, control proceeds to step 702. If the remote computer system is requesting a diagnostic session, control proceeds to step 703. According to an embodiment of the present invention, determining whether a remote computer system is requesting a diagnostic session is achieved by transmitting a query message to the remote computer system via a communications interface, and monitoring the communications interface for a diagnostic session request message from the remote computer system.

At step 702, the operating system is booted up.

At step 703, it is determined whether the remote computer system is authorized to participate in the diagnostic session. If the remote computer system is not authorized to participate in the diagnostic session, control proceeds to step 704. If the remote computer system is authorized to participate in the diagnostic session, control proceeds to step 705.

At step 704, a error message is transmitted to the remote computer system.

At step 705, system status information is transmitted to the remote computer system. The system status information may include a BIOS version number, an initialization report, or other information. The system status information may be used by the remote computer system to determine the types of diagnostics to perform on the computer system.

At step 706, diagnostic software code received from the remote computer system is written into locations in memory as specified by the remote computer system.

At step 707, the diagnostic software is executed.

In the foregoing description, the invention is described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the present invention as set forth in the appended claims. The specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

CLAIMS

In the claims:

1. A method for managing a computer system, comprising:

initiating a reset of the computer system from a remote location; and

running diagnostic software on the computer system downloaded from the remote location.

2. The method of Claim 1, wherein initiating the reset of the computer system from the remote location, comprises:

interfacing the computer system via a remote connection; and

sending a request to a shut down agent in the computer system via the remote connection.

3. The method of Claim 1, further comprising the step of interrogating the computer system to determine types of diagnostic software to download onto the computer system.

4. The method of Claim 3, wherein interrogating the computer system comprises retrieving BIOS information from the computer system.

5. The method of Claim 1, further comprising the step of downloading diagnostic software onto the computer system.

6. The method of Claim 5, wherein downloading diagnostic software onto the computer system comprises transmitting data that includes diagnostic software code and a location in memory to write the diagnostic software code to a communications driver in the computer system.

7. The method of Claim 2, wherein interfacing the computer system via a remote connection, comprises interfacing the computer system via an Ethernet connection to a management module connected to the computer system.

8. The method of Claim 2, wherein interfacing the computer system via a remote connection, comprises interfacing the computer system via a modem connection to a management module connected to the computer system.

9. The method of Claim 2, wherein interfacing the computer system via a remote connection, comprises interfacing the computer system via a serial connection to a serial interface connected to the computer system.

10. The method of Claim 2, wherein interfacing the computer system via a remote connection, comprises interfacing the computer system via a modem connection to a serial interface connected to the computer system.

11. A method for managing a computer system, comprising:

determining whether a remote computer system is requesting a diagnostic session; and

writing diagnostic software code received from the remote computer system into locations in memory as specified by the remote computer system.

12. The method of Claim 11, wherein determining whether a remote computer system is requesting a diagnostic session, comprises:

transmitting a query message to the remote computer system via a communications interface; and

monitoring the communications interface for a diagnostic session request message from the remote computer system.

13. The method of Claim 11, further comprising determining whether the remote computer system is authorized to participate in the diagnostic session.

14. The method of Claim 11, further comprising executing the diagnostic software.

15. A computer-readable medium having a sequence of instructions stored thereon, the sequence of instructions, when executed by a processor, causes the processor to perform the steps of:

determining whether a remote computer system is requesting a diagnostic session; and

writing diagnostic software code received from the remote computer system into locations in memory as specified by the remote computer system.

16. The computer-readable medium of Claim 15, wherein determining whether a remote computer system is requesting a diagnostic session, comprises:

transmitting a query message to the remote computer system via a communications interface; and

monitoring the communications interface for a diagnostic session request message from the remote computer system.

17. The computer-readable medium of Claim 15, further comprising instructions which when executed by the processor causes the processor to determine whether the remote computer system is authorized to participate in a diagnostic session.

18. The computer-readable medium of Claim 15, wherein the computer-readable medium is a read only memory and the sequences of instructions are in a Basic Input Output System (BIOS) of a computer system.

19. An apparatus, comprising:

a shutdown agent that resets a computer system in response to receiving a shut down request from a remote computer system;

a session manager that determines whether the remote computer system is requesting a diagnostic session; and

a data handler that writes diagnostic software code received from the remote computer system into locations in memory as specified by the remote computer system.

20. The apparatus of Claim 19, further comprising a session authorizer that determines whether the remote computer system is authorized to request the diagnostic session.

21. The apparatus of Claim 19, further comprising a system status provider that provides the remote computer system with information to determine types of diagnostic software to download to the computer system.

22. A computer system, comprising:

a bus;

a processor coupled to the bus;

a memory coupled to the bus;

a diagnostic manager, coupled to the bus, that includes a shut down agent that resets a computer system in response to receiving a shut down request from a remote

computer system, a session manager that determines whether the remote computer system is requesting a diagnostic session, and a data handler that writes diagnostic software code received from the remote computer system into locations in memory as specified by the remote computer system.

ABSTRACT

A method for managing a computer system includes initiating a reset of the computer system from a remote location. Diagnostic software on the computer system is downloaded from the remote location.

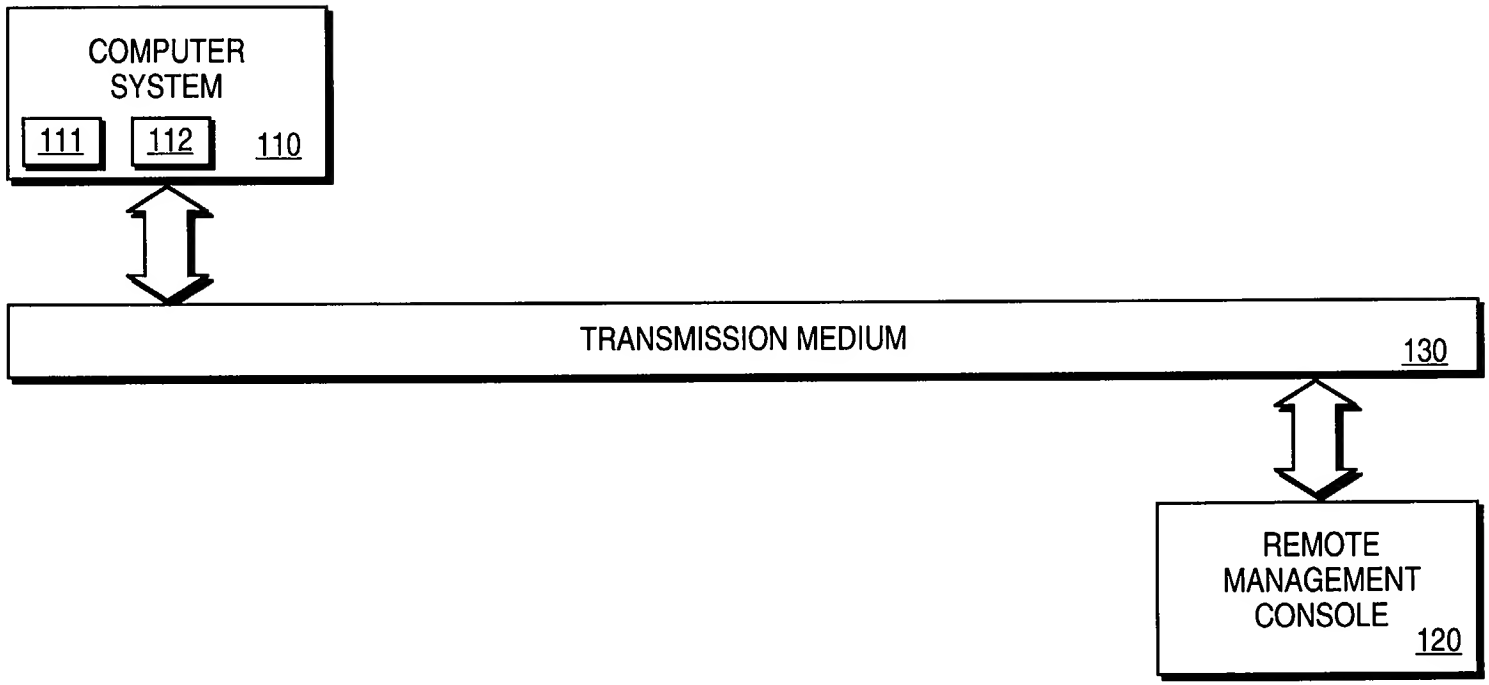
COMPUTER SYSTEM
111
112
110
TRANSMISSION MEDIUM
130
REMOTE MANAGEMENT CONSOLE
120

FIG. 1

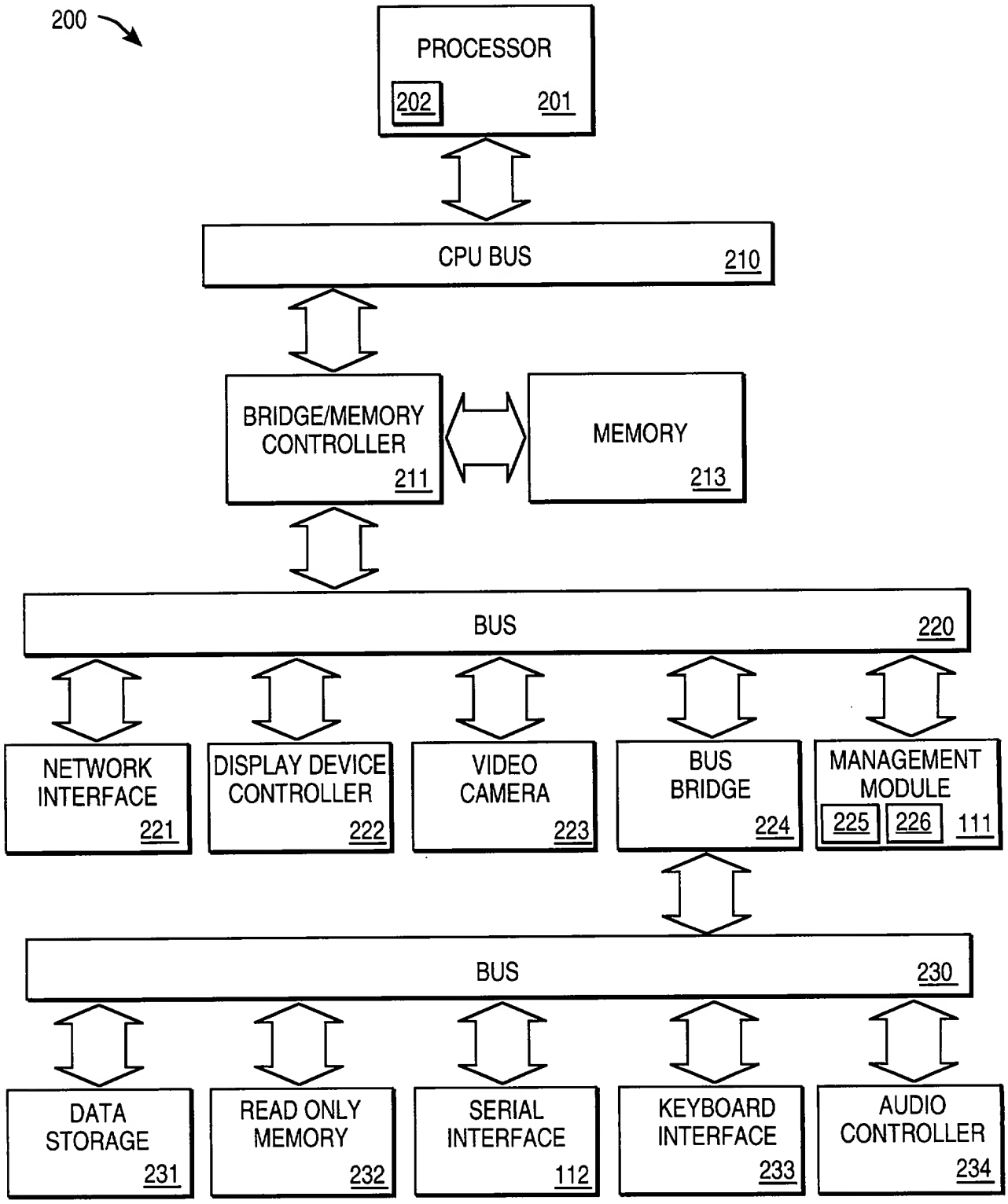
200
PROCESSOR
202
201
CPU BUS
210
BRIDGE/MEMORY CONTROLLER
211
MEMORY
213
BUS
220
NETWORK INTERFACE
221
DISPLAY DEVICE CONTROLLER
222
VIDEO CAMERA
223
BUS BRIDGE
224
MANAGEMENT MODULE
225
226
111
BUS
230
DATA STORAGE
231
READ ONLY MEMORY
232
SERIAL INTERFACE
112
KEYBOARD INTERFACE
233
AUDIO CONTROLLER
234

FIG. 2

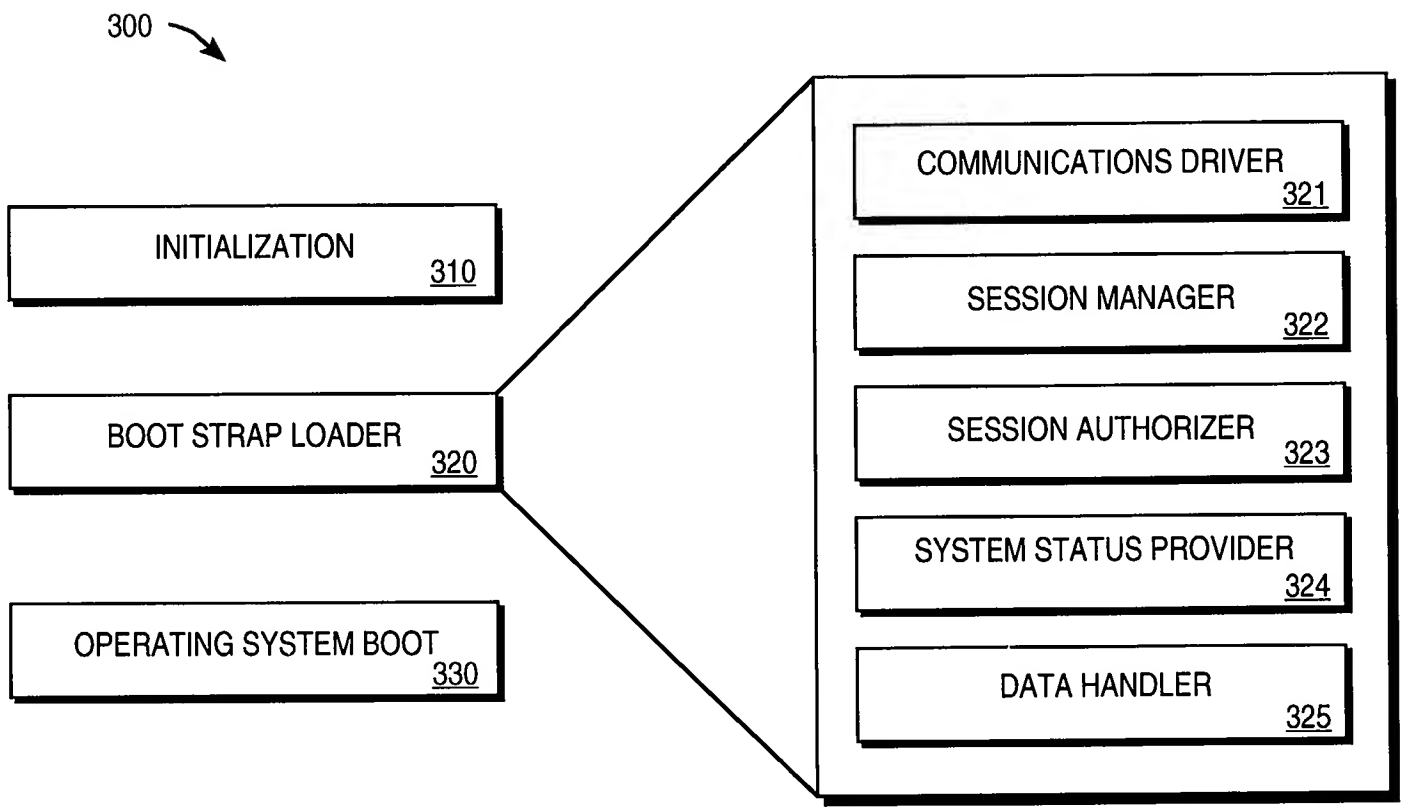
300
INITIALIZATION
310
BOOT STRAP LOADER
320
OPERATING SYSTEM BOOT
330
COMMUNICATIONS DRIVER
321
SESSION MANAGER
322
SESSION AUTHORIZER
323
SYSTEM STATUS PROVIDER
324
DATA HANDLER
325

FIG. 3

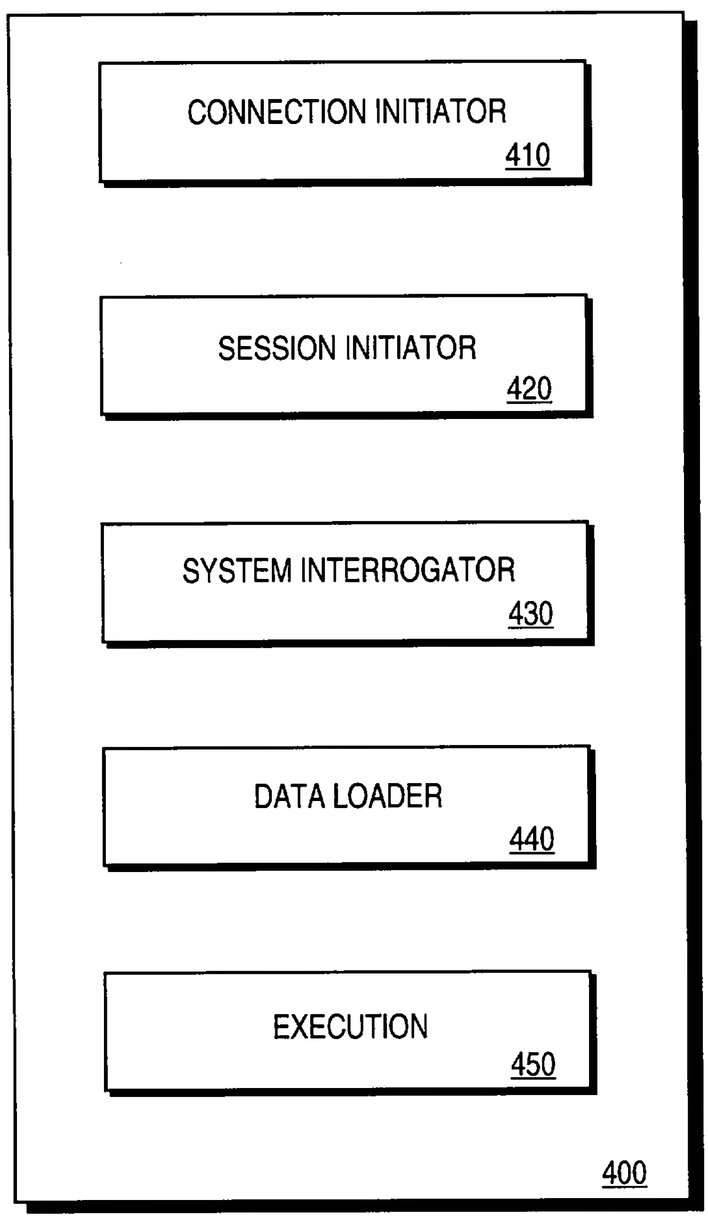
CONNECTION INITIATOR
410
SESSION INITIATOR
420
SYSTEM INTERROGATOR
430
DATA LOADER
440
EXECUTION
450
400

FIG. 4

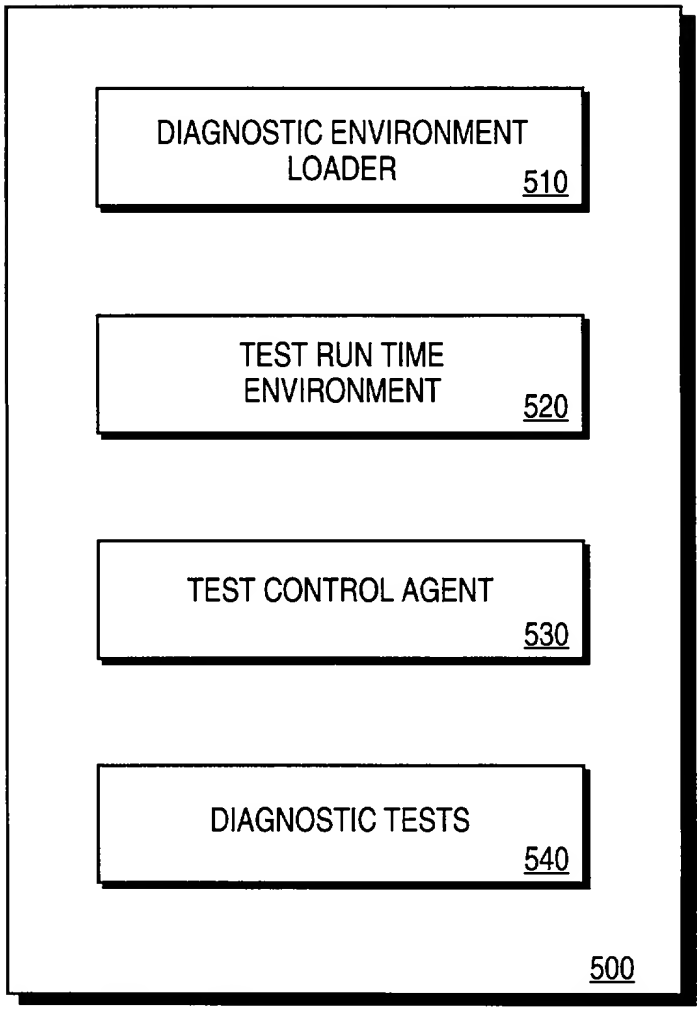
DIAGNOSTIC ENVIRONMENT LOADER
510
TEST RUN TIME ENVIRONMENT
520
TEST CONTROL AGENT
530
DIAGNOSTIC TESTS
540
500

FIG. 5

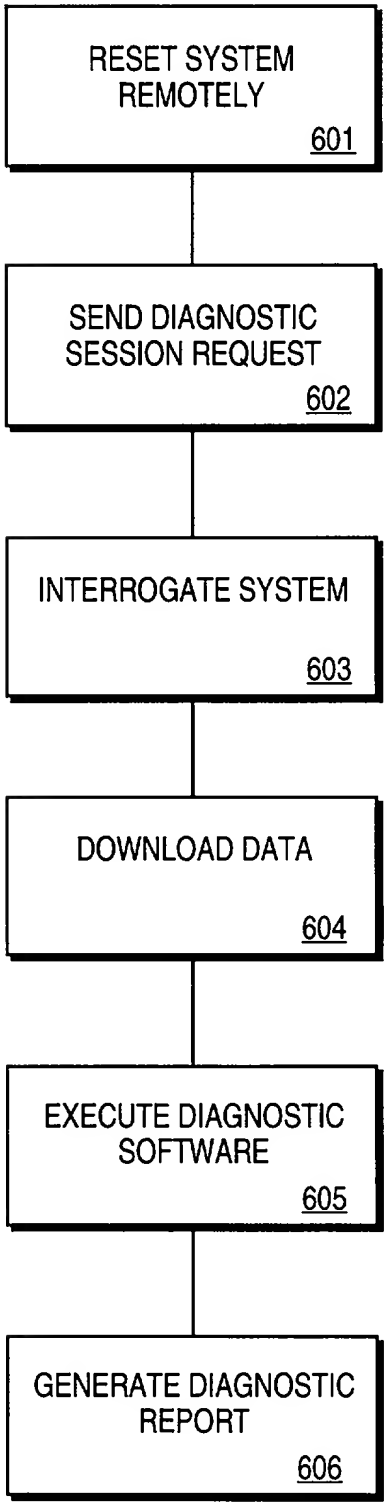
RESET SYSTEM REMOTELY
601
SEND DIAGNOSTIC SESSION REQUEST
602
INTERROGATE SYSTEM
603
DOWNLOAD DATA
604
EXECUTE DIAGNOSTIC SOFTWARE
605
GENERATE DIAGNOSTIC REPORT
606

FIG. 6

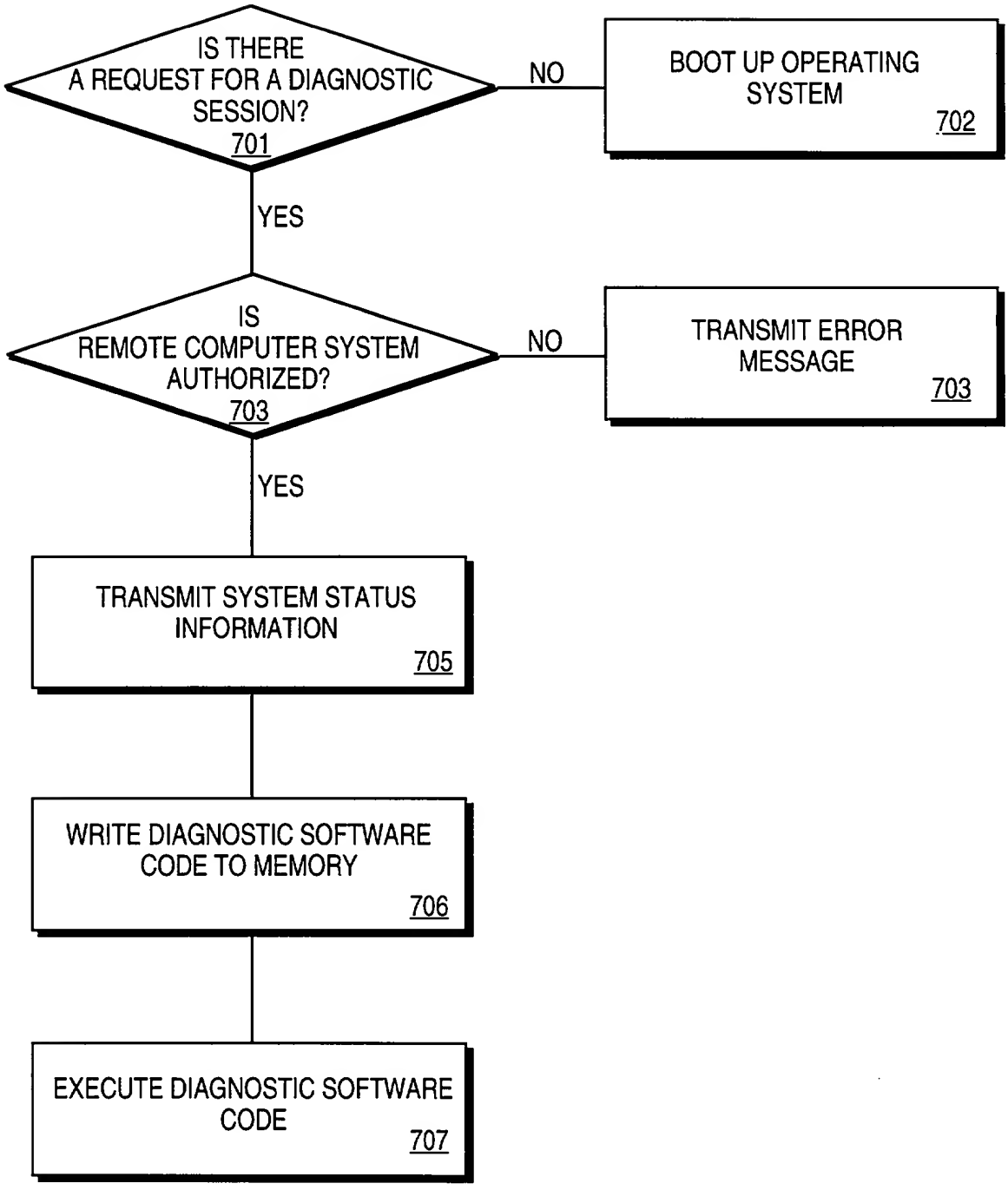
IS THERE A REQUEST FOR A DIAGNOSTIC SESSION? 701
NO
BOOT UP OPERATING SYSTEM 702
YES
IS REMOTE COMPUTER SYSTEM AUTHORIZED? 703
NO
TRANSMIT ERROR MESSAGE 703
YES
TRANSMIT SYSTEM STATUS INFORMATION 705
WRITE DIAGNOSTIC SOFTWARE CODE TO MEMORY 706
EXECUTE DIAGNOSTIC SOFTWARE CODE 707

FIG. 7

Attorney's Docket No.: 042390.P5358 PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
(FOR **INTEL CORPORATION** PATENT APPLICATIONS)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR PERFORMING
FIELD DIAGNOSTICS ON A COMPUTER SYSTEM

the specification of which

__X__ is attached hereto.

_____ was filed on _____ as United States Application Number _____ or PCT International Application Number_____ and was amended on _____. (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

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(Name of Attorney or Agent)
ZAFMAN LLP, 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025 and direct telephone calls to LAWRENCE M. CHO, (408) 720-8598.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the

United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Robert J. Woodruff

Inventor's Signature Robert J. Woodruff Date 7/7/98

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Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.